

Assessment of the transversal competences: analysis and resolution of problems and, planning and time management

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Abstract

European universities are in the process of experimenting with teaching by applying the new learning model according to the Bologna plan, based on specific and transversal competences. Due to the old teaching model, which is still rooted in the current learning system, professors have difficulties in assessing transversal competences. In this paper, the results of applying a methodology to assess the transversal competences: analysis and problem solving, and planning and time management is presented. Although the methodology is designed to evaluate transversal competences, it could also be used to evaluate traditional specific competences, in which the acquired technical knowledge is assessed. The methodology consists of explaining to the student how a practical problem is solved, applied to a case that an engineer can find in professional life. Subsequently, the student must solve another problem of the same type raised by the professor. The student will be given a limited time to solve the problem. The methodology is applied in two different sessions. The students have previously been informed about the performance of the test. Unlike the traditional method, the student must prepare the class before the lecture. Therefore, when the professor explains the theoretical part and how to solve the problem, it can also resolve doubts raised by the student during the preparation of the session. Additionally, the students who take less time to solve the test will have a higher score in the assessment of planning and time management. The results obtained are analysed and improvements are proposed to facilitate the acquisition of skills.



Keywords: *Transversal competences, Assessment, Specific competences.*

1. Introduction

Transversal or key competences are a set of competences related to attitudes, values, and procedures that are acquired in one context to master a special situation and can be transferred to another context. (EUROPEAN COMMISSION, 2018).

Due to their importance in the European Higher Education system, transversal competences assessment has been treated in several teaching publications (Cáceres, Martínez, Noguera, Pérez, & Sanabria-Codesal, 2016) (Fernández, Mallol, Chornet, Noguerae, & Gutiérrez, 2017) (García-García, 2009) (Mula, Sanchis, & Díaz-Madroñeroa, 2017) (Verdecho, Pedro-Gómez-Gasquet, Rodríguez-Rodríguez, & Alfaro-Saiz, 2016) (Verdechoa, Rodríguez-Rodríguez, Alfaro-Saiza, & Gómez-Gasqueta, 2018). European universities are in the process of experimenting with teaching by applying the new learning model according to the Bologna plan, based both on specific and transversal competences.

According to (CompAssess, 2019), competence is not only an individual phenomenon but is a social-cultural phenomenon in a way in which, the categories ‘individual’ and ‘organization’ are inevitably entangled with another. Hence that it becomes impossible to draw the boundaries between the two. The question is what we can actually say about competences and transversal competences and how can we measure it.

Due to the old teaching model, which is still rooted in the current learning system, and the lack of a relationship between university and professional life, professors have difficulties in assessing transversal competences. In this paper, a methodology for the assessment of the transversal competences analysis and resolution of problems (TC-03) and, planning and time management (TC-12) has been carried out and implemented in the course of Thermal Renewable Energy of the Bachelor's Degree in Energy Engineering. Both transversal competences are in the list of transversal competences at the Universitat Politècnica de València (Universitat Politècnica de València, 2017).

The goal of this paper is to apply a methodology for assessing the transversal competences: analysis and resolution of problems; and planning and time management. Afterwards, the results obtained with the application of such methodology are analysed.



2. Methodology

Before applying the methodology, it is explained to the student how a practical problem is solved, to apply it to a case that an engineer can find in professional life. Subsequently, the student must solve another problem of the same type raised by the professor. The students will have a limited time to solve the problem, and they have previously been informed about the test. The student must prepare the test before the lecture in which the test is carried out. Therefore, when the professor explains the theoretical part and how to solve the problem, he can also resolve doubts raised by the student during the preparation of the session. At the end of the session, the students must carry out the test.

The methodology applied is based on (Verdechoa, Rodríguez-Rodríguez, Alfaro-Saiza, & Gómez-Gasqueta, 2018) and (Universitat Politècnica de València, 2017). Since the competences to be evaluated are: analysis and resolution of problems (TC-03) and, planning and time management (TC-12), the student must solve a problem raised in a limited period of time. The methodology of the process is shown in Figure 1. The methodology was applied in two different sessions for two different topics. Unlike the traditional method, to carry out the test as similar as possible to a real problem, the student can consult notes, computer, tablets, etc.

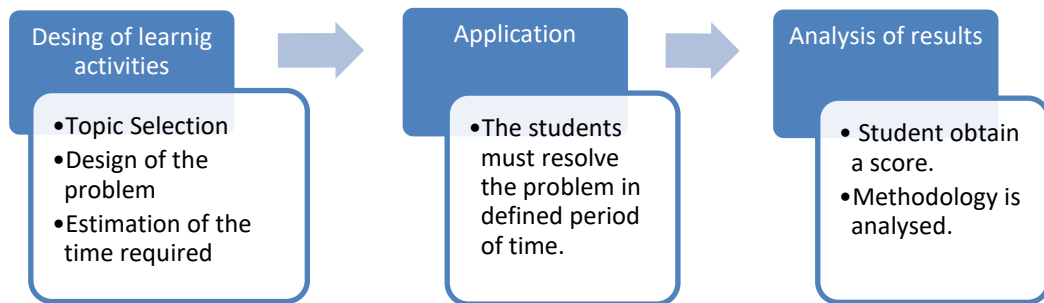


Fig. 1 Methodology applied for assessing transversal competences

Source: (Verdechoa, Rodríguez-Rodríguez, Alfaro-Saiza, & Gómez-Gasqueta, 2018)

The methodology consists of three steps, as shown in Figure 1. In the first step, the learning activity is designed. The design includes the topic selection, the problem to be solved by the students and the estimation of the time required to solve the problem. The assessment instrument is a real problem that must be solved by the students. Figure 2 shows the two problems raised in two different sessions.

Grado en Ingeniería de la Energía - ENERGÍAS RENOVABLES TÉRMICAS
Problema para resolver en clase
 Competencias transversales: análisis y resolución de problemas, planificación y gestión del tiempo

Objetivo: que el estudiante aprenda a resolver problemas de cálculo del poder calorífico de la biomasa a partir de bases de datos, utilizando la ecuación de Mier y disponiendo de un tiempo determinado.
 Tiempo para resolver el problema: 15 min

Alumno: _____
 Fecha: _____

Ejercicio caracterización. Poder calorífico

Property	Poda de sarrajo	Value			Std dev
		wt	dry	ash	
Proximate Analysis					
Moisture content	wt%	31.09	—	0.00	
Volatile matter	wt%	55.78	80.95	54.86	0.00
Ash content at 815° C	wt%	3.02	4.38	—	0.00
Fixed carbon	wt%	10.11	14.67	13.34	—
Ultimate Analysis					
Carbon	wt%	22.01	46.49	48.58	0.00
Hydrogen	wt%	3.85	5.29	5.53	0.00
Nitrogen	wt%	0.71	1.03	1.08	0.00
Sulphur	wt%	0.06	0.09	0.09	0.00
Oxygen	wt%	23.47	42.76	44.72	0.00
Total (with halides)	wt%	100.00	100.00	100.00	—

a) Calcular el PCS (HHV) y el PCI (LHV) en MJ/kg y en base seca de una muestra de poda de sarrajo, partir de la composición elemental obtenida en la base de datos PHYLLIS. Utilizar la fórmula de Mier.
 b) Recalcular los valores utilizando la humedad dada en la base de datos.

Espectro: Orange tree pruning (#3349), <https://www.ecn.nl/phyllis/Browse/Standard/ECN-Phyllis/pruning>

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Objetivo: que el estudiante aprenda, disponiendo de un tiempo determinado, a resolver problemas para calcular y mejorar la eficiencia de una caldera que utiliza como combustible biomasa.
 Tiempo para resolver el problema: 20 min

Alumno: _____
 Fecha: _____

Diagnóstico de la combustión en calderas de biomasa

a) Se realiza el análisis de combustión a una caldera pirólitica de dos pasos que utiliza como combustible serrín. Los resultados son: $T_{amb} = 25^{\circ}\text{C}$, $T_a = 200^{\circ}\text{C}$, $O_2 = 3\%$, $CO = 4.000\text{ ppm}$, $CO_2 = 14\%$, Índice de Bacharach (IB) = 4. Calcular: Coeficiente de exceso de aire y Eficiencia de la combustión por el método indirecto.

b) Si la caldera consume 100.000 kg/mes (100 t/mes) de serrín, en cuanto disminuirá el consumo mensual de biomasa (kg/mes y €/mes) si se ajusta la combustión y el O_2 sube al 4%, el CO baja a 2.000 ppm, el CO_2 sube a 17% y además se limpia el intercambiador de la caldera y la temperatura de humos baja a 170°C ; y el IB baja a 2. (Coste de la biomasa es 0,20 €/kg).

Fig. 2 The problems raised to assess the TC-03 and TC-12

According to (Universitat Politècnica de València, 2017), a scale with 4 values has been defined to assess the point of development of the transversal competences reached by the students A, B, C, D. Table 1 shows the meaning of every level (represented by the letters from A to D) and the relation used in this paper to scale the score from 0 to 10 obtained by the student. When more than one test is carried out, it is useful to assess using a numeric value, since it is possible to obtain an average final score that can be converted into one of the four levels for easily evaluating the transversal competences.

Table 1. Levels for evaluating the transversals competences

Level	Meaning	Score range (1 to 10)
A	Excellent	9 - 10
B	Adequate level	7 - 8,9
C	Developing	5 - 6,9
D	Development not reached	0 - 4,9

Source: (Universitat Politècnica de València, 2017)

The algorithm of the second part of the methodology applied is shown in Figure 3. Unlike the traditional method, the students have different range of times to solve the problem raised. Once the students receive the problem, they have three different limited range of time to finish the problem. If the students solve the problem without mistakes in the initial time raised, it is obtained the best score in both competences. If the students cannot resolve the problem in the defined time, they have 20% extra time to try to finish the problem. If the students solve the problem properly, it is obtained the maximum score in TC-03 and 8/10 (equivalent to B) in the final score for TC-12. If so far, the student has not been able to solve the problem; it has 40% extra time respect to the initial time. If after this time the problem is solved, it is obtained the maximum score in TC-03 and a 6/10 (equivalent to C)



in the final score for TC-12. Finally, if the student does not know how to solve the entire problem, the score for TC-03 will be equal to the proportional solved part in the scale from 1 to 10, and the score for TC-12 will be 3 (Equivalent to D). The student must solve other problems by mean of other tests during the course, then the final score of the competence will be the average grade according to Table 1.

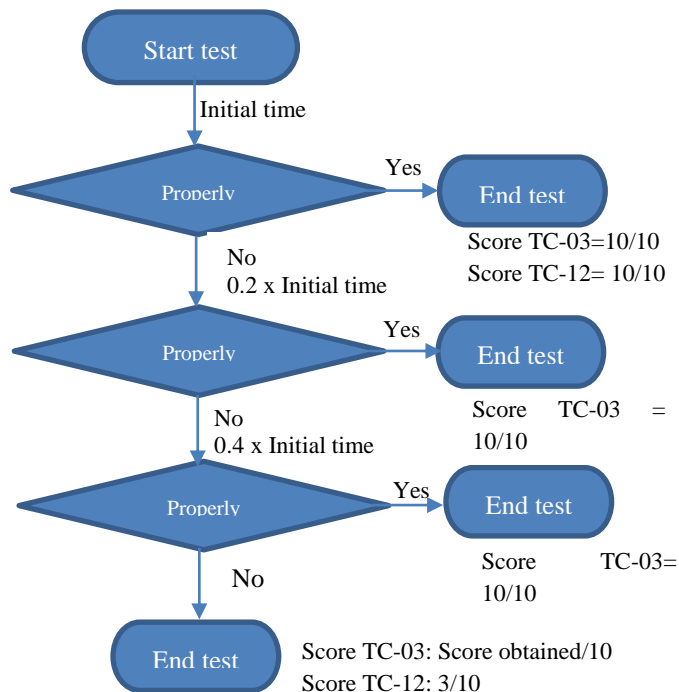


Fig. 3 The algorithm applied for assessing transversal competencies. The final score is the average of all the test performed.

3. Results

Results of the assessment analysis, obtained from Figure 4, show that 92% of the students have reached the minimum level of development required in CT-03. In the case of CT-12, 75% of the students have reached the minimum level of development required. Similarly, 39% of the students have reached the maximum level in CT-03, and 28% have reached the maximum level in CT-12. On the other hand, 8% of the student have no reached the minimum required level in CT-03, and 25% of the student have not reached the minimum level required in CT-12.

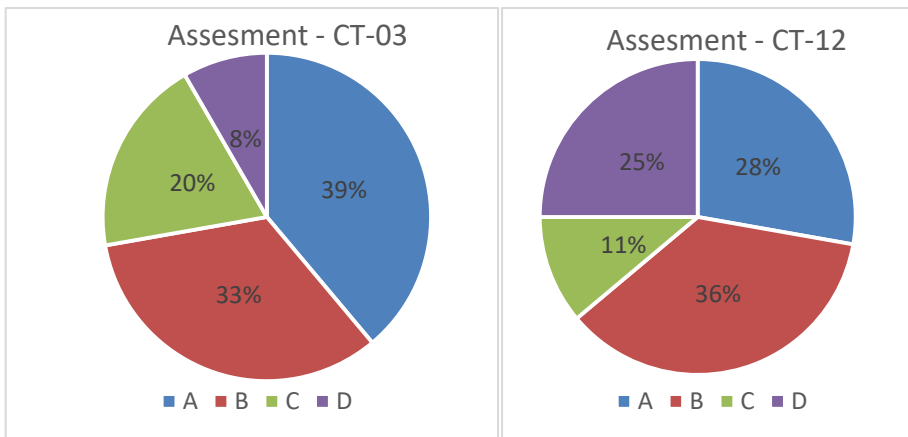


Fig. 4 Results of the methodology applied for assessing the TC-03 and TC-12.

Figure 5 shows the final score for each of the 36 students in the 0 to 10 scale for the CT-03, and in the A to D scale for CT-12. Only 1 student Scored 0 in the final grade scale from 1 to 10 points for CT-03.

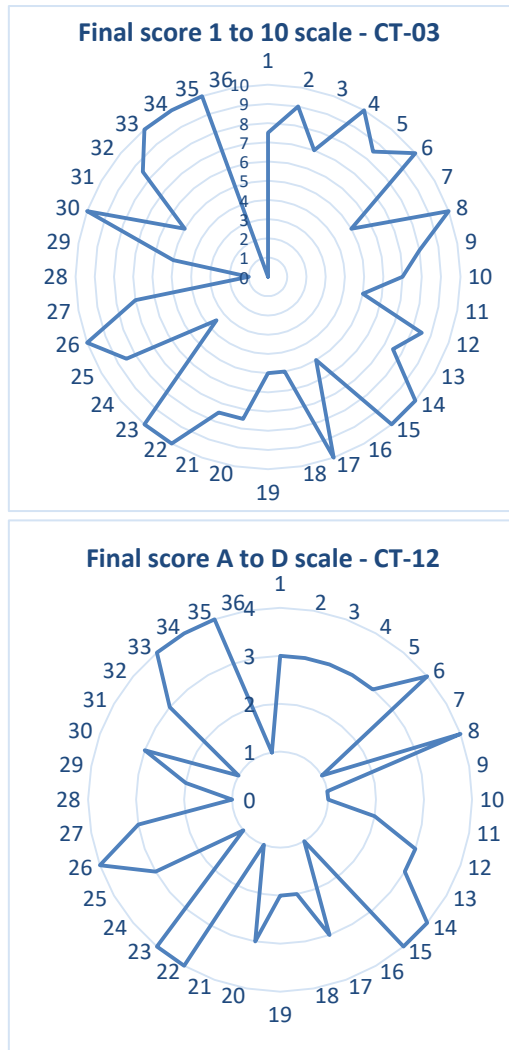


Fig. 5 Final score for CT-03(0 to 10 points scale) an for CT-12 (0 to 4 points scale, where 1=D; 2=C; 3=B; 4=A)

The methodology has been applied to a theoretical part of the subject Thermal Renewable Energies. Nevertheless, the methodology could be applied to a practical part of the subject. If the competence to be evaluated is related to a specific technical part, as is the case of transversal competence 13 (Specific instruments), surely, the results obtained would be more realistic.

Finally, a survey for assessing the methodology has been carried out. The results are shown in Figure 6. Where 44% of student have scored the methodology with a grade greater than 8 and only 8%, have scored the methodology with a grade less than 5.

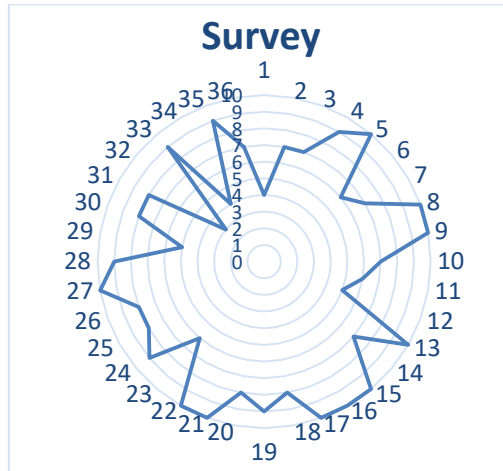


Fig. 6 Results of the survey carried out for assessing the methodology applied.

4. Conclusions

In this paper, a methodology for assessing the transversal competencies CT-3 and CT-12 has been developed and applied. This methodology can be applied to other transversal competencies. Once the initial defined time to perform the test is finished, the student has the possibility of continuing working for an extra period. Then it is possible to assess the CT-12 according to the time expended by the student to solve the problem. The students have assessed the methodology in a very positive way, which has been positively rated by 92% of students.

The methodology has been applied to a theoretical part of a subject. Nevertheless, if the methodology is applied to a practical part of a subject, surely, results obtained would be more realistic when a technical transversal competence is evaluated.

To save time, the test can be designed for assessing both: transversal competences and the final grade of the subject. The methodology used in this paper was designed for covering both purposes.

Finally, the results obtained are consistent. According to the results, the student receives feedback to improve the deficiencies detected in both: analysis and resolution of problems; and planning and time management.

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